NORTHROP GRUMMAN

Ship Systems

Integrated Engineering Plant – What's It Really All About?

NGSS R&D

Anteon ETC

10 August 2004

NGSS R&D Role in Technology Transition

- **Find "de-risked" technologies**
  - **Mature COTS with low risk of failure**
  - **Mature ONR programs**
  - **International partners**
- **Develop programs to effect risk mitigation**
  - **ATD model for shipboard demonstrations**
- **Steer promising research by others**
  - **Working with SBIR/STTR contractors, universities, etc.**
  - **Teaming with industry partners**

Introduction

- **Background**
- **Integrated Engineering Plant (IEP) Concept**
- **IEP Strategy**
- **Planned Effort**
- **Summary**

Background

- **Technology "Push" Exists**
  - **Electronics, Communications, Control System Advances, Decision Aids, Advanced Reasoning, Intelligent Agents**
- **Customer "Pull" Also Exists**
  - **Manning Reductions, Survivability, Electric Warship, Future High Energy Weapons and Sensors**
- **How Do We Bridge The "Valley of Death"?**

NAVSEA Electric Warship Vision

Integrated Power System

- Electric Drive
- Reduce # of Prime Movers
- Fuel Savings
- Reduced

All Electric Ships

- ***Integrated Engineering Plant***
- Reduced Manning
- Automation

Electric Warships

- Technology Insertion
- Warfighting Capabilities
  - Enhanced Stealth
  - Increased Payload Volume
  - Reduced Logistics Dependency
  - Power Availability &

Increasing Affordability and Military Ca

and Sensors

Fleet S&T Priorities

Surface Community S&T Needs

Advanced Damage Countermeasu

Damage Tolerant Power Architect

Situational Awareness

10 Jan 2003

Commander, US Naval Surface For

Carrier Technology S&T Investment Priorit

Advanced Damage Countermeasures (Hybr

Damage Tolerant Power Architectures

12 Nov 2003

Director Warfare Integration and Assessment (N70)

IEP Concept

Mission Coordination Layer
- ***Operator Interface***
- ***Decision on current situation***

Mission priorities determined
- **Objective**
- **Threat**
- **Efficiency**
- **Condition - Readiness**

System (Intra & Inter) Coordination Layer
- **Intelligent Agents**
- **Advanced Reasoning**
- **Decision Aids**
- **System Interactions**

Ship's LAN

Autonomous System Layer
- ***Component Level Intelligence***
- ***Intelligent Agents***

Electrical System Management ***Signature Management*** ***Structural Monitoring***

Damage Control ***Propulsion Control*** ***Fluid System & Cooling Management*** ***Ventilation System Control***

What do we get from IEP?

- **Increased Survivability**
  - **Dynamic Mission Reconfigurability (Pre-hit, post-hit)**
- **Increased Combat Effectiveness**
  - **Fight-through / graceful degradation of critical combat system resources**
  - **Situational awareness of available resources / status**
  - **Payload fraction higher than legacy designs, especially for smaller ships**
- **Reduced Total Ownership Cost**
  - **Manning workload**
  - **Equipment health monitoring**
  - **COTS availability**
- **System Wide Integration**
  - **Component level intelligence**
  - **Scalable**

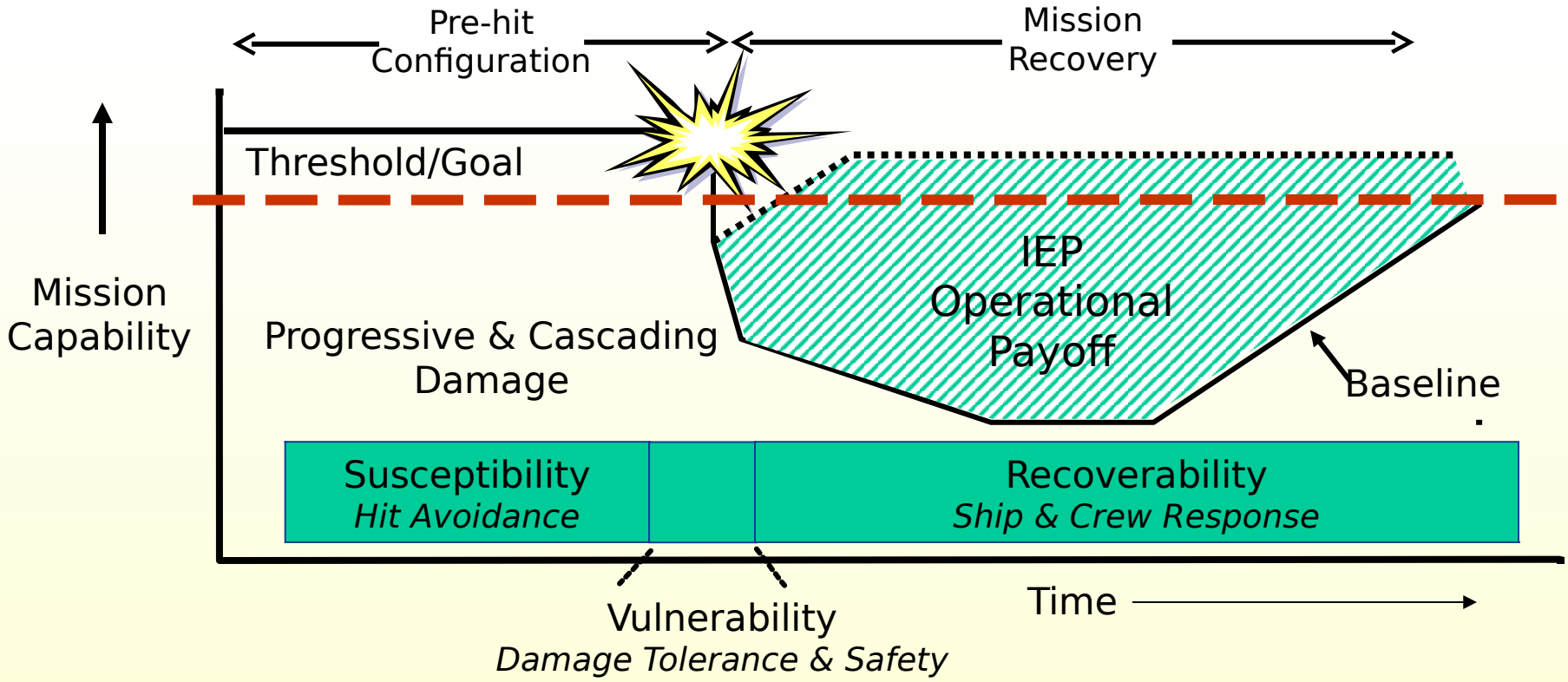
IEP Strategy

- **What will IEP do for the warfighter?**
- **What are the enabling technologies?**
- **How do we mitigate risk to transition the technology to the fleet?**

IEP Warfighter Benefits

- **Robust network, fault tolerant and self healing**
  - **Network Fragment Healing (NFH)**
- **Reduces operator intervention / workload**
  - **Warfighter focuses on fighting ship, not operating machinery**
- **Combat support systems stay online**
  - **Mission critical systems remain operational or degrade gracefully**
- **Reduces total ownership cost**
  - **Open architecture, design reconfiguration**
  - **Plug and play multi-vendor capable**
- **Enables active signature management**
  - **Rule-based machinery alignment from top-level tactical input**

IEP Payoff



- Reduce ***susceptibility*** through signature management
- Reduce ***vulnerability*** through damage tolerant architectures
- Speed ***recoverability*** through situational awareness and reconfigurability

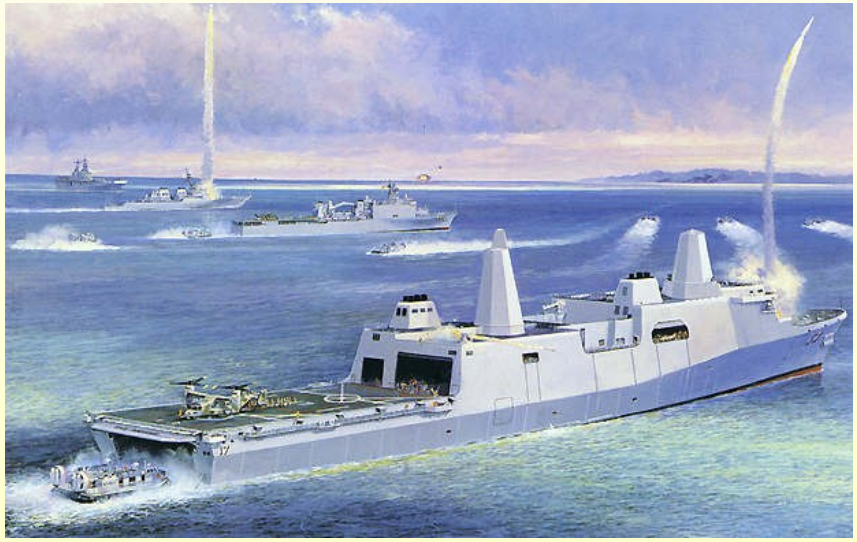
Enabling Technologies Are Maturing

- **Distributed component-level intelligence**
- **Decision aids**
- **Fault tolerant control network topology**
- **System Information for Machinery Health Monitoring**
- **Reconfigurable power and auxiliary systems**

IEP Risk Mitigation

- **Build on existing efforts**
  - **Prior work on YP 679**
  - **NSWC work on CW RSAD System**
  - **NRL work on DC-ARM Program (AFSS, etc.)**
  - **Systems Engineering studies**
  - **DIAS Thrust Area Emerging Technologies**
- **Use proven program management approach**
  - **NGSS R&D experience with AEM/S**
  - **Large scale ATD experience**
- **Shipboard Demonstration of IEP Strategy**
  - **Key to Overcoming “Valley of Death”**

Technology Transition in Action



Shipboard Demonstration - Options

- **Retrofit existing ship (preferred)**
  - **Proposed DD(X) EDM at-sea platform (Ex-DD963 Class Ship - TBD)**
  - **USS FOSTER (DD964) or USS PETERSON (DD969) (proposed Self Defense Test Ships)**

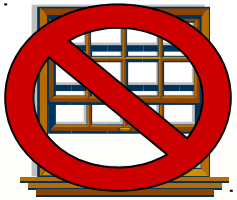
- **Design into new ship**
  -

Planned Effort

- **Develop next generation system using technologies ready for implementation**
- **Stepwise proof of concept**
  - **Land-based → Sea-based**
- **Thorough testing at all stages of program**
  - **Software and hardware proven before ship installation**
- **Modify machinery systems / hardware aboard test ship as required (similar to YP 679)**
- **Implement control strategy and autonomous decision aids**
- **Demonstrate scalable reconfigurability and survivability**

IEP Transition Opportunities

DD(X)
Land Attack Destroyer

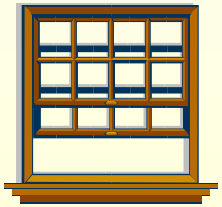


- Baseline machinery plant desig
- Slight potential for Flight II
- NGSS Prime Contractor
- NAVSEA PMS 500

LCS
Littoral Combat Ship

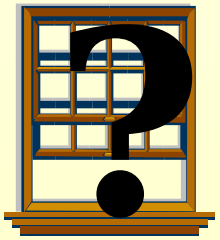
- Transition window open.
- 12 – 24 month opportunity to in
- 2 Prime contracts – LM and GD
- NAVSEA PMS 501

WPC
Maritime Patrol Coastal



- Transition window open.
- 18 – 30 month opportunity to in
- NGSS Prime Contractor
- USCG Deepwater

CG(X)
Air Defense Cruiser



- Use DD(X) baseline?
- Opportunity to impact?
- Prime Contractor – NGSS/GD
- PEO SHIPS

Summary

- **IEP program MUST be demonstrated to gain needed acceptance for widespread adoption**
- **NGSS and Anteon plan to demonstrate IEP**
- **We need to work together to ensure that future Navy ships have this vital capability**